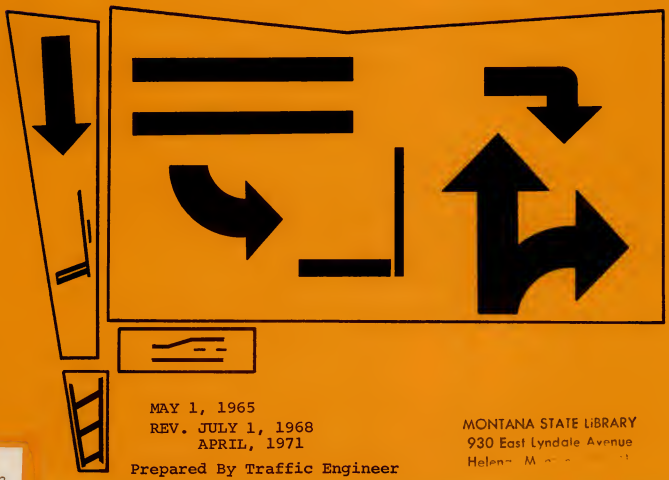
MONTANA STATE HIGHWAY COMMISSION

PAVEMENT MARKINGS



MAY 1, 1965
REV. JULY 1, 1968
APRIL, 1971

Prepared By Traffic Engineer

STATE HIGHWAY DEPARTMENT
HELENA, MONTANA

April 20, 1971

M E M O R A N D U M

TO: DISTRICT & DIVISION ENGINEERS

FROM: LEWIS M. CHITTIM, P.E., STATE HIGHWAY ENGINEER

SUBJECT: MANUAL ON "PAVEMENT MARKINGS"

The attached manual entitled "Pavement Markings" was prepared by the Traffic Engineer's Office in cooperation with the Maintenance Engineer. This manual replaces the manual issued in September 1968. Copies of the 1968 manual should be destroyed. All pavement markings accomplished by The Montana Highway Department forces should conform as nearly as practicable to the 1971 manual.

Pavement markings are important traffic control and safety devices. If they are to be useful and meaningful to the public, pavement markings must be used properly and uniformly. The 1971 manual is part of a continuing effort to improve and standarize our practices.

Additional copies of this manual are available from the Traffic Engineer's Office. Please refer questions, suggestions, or comments to the Traffic Engineer or the Maintenance Engineer.

Lewis M. Chittim, P.E.,
State Highway Engineer

Attachments

DISTRIBUTION:

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PAVEMENT MARKINGS

A

Supplement

TO THE

MANUAL ON UNIFORM TRAFFIC CONTROL

DEVICES FOR STREETS AND HIGHWAYS

As Prepared By

Traffic Engineers Department

MONTANA HIGHWAY COMMISSION

Revised April 20, 1971

STATE HIGHWAY COMMISSION

Helena, Montana
April 19, 1971

STANDARDS FOR PAVEMENT MARKINGS

I. INTRODUCTION:

In order to bring pavement markings on the entire State Highway System to a higher order of uniformity and to conform more closely with the "Manual on Uniform Traffic Control Devices", these standards are for the use of all who have the responsibility for providing pavement markings on the State's highways.

The standards shown herein are to be considered a supplement to the Uniform Manual, covering in more detail those pavement markings most frequently used throughout the State.

A. The following types of markings are covered:

1. Center lines. (Figure 1)
2. Lane lines. (Figure 1)
3. No-passing barrier lines. (Figures 2-6)
4. Pavement edge lines. (Figure 1)
5. Transitions. (Figure 7)
6. Channelization. (Figures 8, 9, & 10)
7. Acceleration - deceleration lane markings. (Figure 11)
8. Layout symbols. (Figures 12 & 13)
9. Truck climbing lanes. (Figure 14)
10. School crossings. (Figure 15)
11. Railroad crossings. (Figure 16)
12. Word and symbol markings. (Figures 17 & 18)
13. Parking space limits. (Figure 19)

B. Reflectorization: All pavement markings shall be reflectorized by the use of glass beads, either pre-mixed or drop-on method, or a combination of both methods.

C. Colors: Pavement markings shall be either white or highway yellow in color. Center lines and No-passing barrier lines shall be yellow in color. Left edge lines on one-way roadways shall be yellow where a curb or guardrail is used in the median. Lane lines, and pavement edge lines shall be white in color.

D. Size: Longitudinal pavement lines shall be 4 inches wide. Rural center lines and lane lines shall be 15 feet long with a 25 foot gap between segments. In urban areas, a 9 foot long line shall be used with a 15 foot gap.

E. Maintenance: All markings shall be kept in good order and clearly visible at all times. The frequency of re-striping will depend upon the type of surface, density of the traffic and the quality of the last striping.

II. PAVEMENT MARKINGS:

A. Center lines:

1. Rural, two-lanes, two-way - a broken yellow line, 4 inches wide, 15 feet long with a 25 foot gap between segments. (Figure 1)

2. Rural, four or more lanes - two solid yellow lines, 4 inches wide separated by a space of not less than 4 inches. (Figure 1)

3. Urban, two-lane - a two-way street shall have a broken yellow center line, 4 inches or more wide. On a one-way street the center line is a lane line and shall be broken white line, 4 inches or more wide, 9 feet long with a 15 foot gap between segments. (Figure 1)

4. Urban, four or more lanes - a two-way street with four or more lanes for moving traffic at all times shall be a double solid yellow line. (Figure 1)

B. Lane lines: Lane lines shall be used on multi-lane highways and one-way streets.

1. Rural roads - lane lines shall be broken white line, 4 inches wide, 15 feet long with a 25 foot gap between segments. (Figure 1)

2. Urban streets - lane lines shall be broken white line, 4 inches wide, 9 feet long with a 15 foot gap between segments. (Figure 1)

3. High speed boulevards and controlled access highways in urban areas will be marked the same as rural highways.

C. No-Passing zones: No-passing zones shall be marked by a solid yellow barrier line placed on the right-hand side of a center or another barrier line. The marking for no-passing in either direction shall be two solid yellow barrier lines.

D. Warrants for no-passing zones: No-passing zones are warranted when the sight distance ahead is less than that for safe passing at the speeds prevailing on the highway and in advance of those situations where passing is particularly hazardous, such as narrow bridges and certain intersections. Sight distance on a vertical curve is the

D. distance at which an object 3.75 feet above the pavement can just be seen from another point 3.75 feet above the pavement, as illustrated in Figures 2 and 3. Similarly, sight distance on a horizontal curve is the distance measured along the center line between two points 3.75 feet above the pavement on a line tangent to the embankment or other obstruction that cuts off the view on the inside of the curve. (Figure 4)

TABLE NO. I

85% Speed on Highway M.P.H.	Highway characteristics that may be used to classify speed rating in lieu of determination of 85% speed.			Minimum Sight Distance
50	Pavement Width	-	22 feet or more	800 feet
	Horizontal Curve	-	Maximum 10°	
	Vertical Curve	-	Min. K. Value = 85	
60	Pavement Width	-	24 feet	1,000 feet
	Horizontal Curve	-	Maximum 6°	
	Vertical Curve	-	Min. K. Value = 160	
70	Pavement Width	-	28 feet or more	1,200 feet
	Horizontal Curve	-	Maximum 3°30'	
	Vertical Curve	-	Min. K Value = 255	

K value, as shown above, is a co-efficient by which the algebraic difference in grade may be multiplied to determine the length in feet of the vertical curve which will provide minimum stopping sight distance.

It is suggested that each District Engineer prepare a map of the highways in his District and classify each section into the above 3 speed classifications.

The minimum length of a No-passing zone in a rural area shall be 500 feet. If the actual No-passing distance is less than 500 feet in length, the additional length of marking shall be added at the beginning.

When the distance between the end of one No-passing zone and the beginning of the following No-passing zone is less than 600 feet, the zones shall be extended through the intervening distance. (See Figure 3)

When two paved highways intersect, the approaches to the intersection shall be striped as No-passing zones for a distance of 300 feet in urban areas and 500 feet in rural areas. (See Figure 6)

When a bridge has a curb-to-curb width of less than 24 feet, a 500 foot No-passing zone shall be marked for each approach lanes. (See Figure 5)

Truck climbing lanes shall be striped as shown in Figure 14. Truck - climbing lanes should not be striped unless at least 36 feet of surfacing is available for use as a traveled way.

E. Pavement edge lines or shoulder lines: A solid white 4 inch edge line shall be used wherever there is a paved roadway surface of 24 feet or more. Divided multi-lane highways shall have the inside shoulder striped. Where the median is paved flush with the traffic lanes, the double yellow barrier line shall be used in all cases. (See Figure 1)

F. Striping through intersections: Ordinarily center lines and lane lines will not be continued through an intersection of any public side road approach. Under no circumstances will the pavement edge lines be carried through an intersection. Center line, lane lines and edge lines will not be broken for private driveways or approaches. If there is a need to provide guidance vehicles through an intersection area because of difficult geometrics or sight distance restrictions, center lines and lane lines may be extended by the use of dotted lines. Dotted lines will be the same width and color as the lines which they are used to extend. They will be two feet in length and have gaps normally four to ten feet longer. Edge lines, center lines and lane lines should not be broken for driveways or private road approaches.

G. Transitions: Pavement markings at transitions should be laid out very carefully. Uniformity is a must, due to the higher speed encountered at the Interstate transitions and the increase in the number of such facilities. A number of situations are possible; however, two typical transitions are illustrated in Figure 7.

H. Channelization: The channelizing line shall be a solid white line, generally 8 to 12 inches in width. Figures 8, 9 and 10 illustrate some typical uses of this line; however, the Uniform Manual lists many other uses of the line.

I. Acceleration and deceleration lane markings: Geometric design sets rigid controls on acceleration and deceleration lane markings. Because the function of the facility depends so much on proper markings, it is imperative that each acceleration and deceleration lane is carefully laid out, using the road plans as a guide. Figure 11, illustrates the

I. proper markings and their location. Figures 12 and 13, show the layout deceleration lane shoulder marking; a definite angle point must be evident to the approaching vehicle in order to distinguish the ramp exit from the main travel lane.

J. Truck climbing lanes: Truck climbing lanes are striped for no-passing throughout the length of the additional widening on the uphill lane. No-passing zones on the downhill lane are limited to those areas where the sight distance is less than shown on Table 1. The tapers used to introduce the additional lane should be delineated by the use of a shoulder or pavement edge stripe. Here again, care should be used in laying out the angle points in order to define the beginning and end of the widening. (See Figure 14)

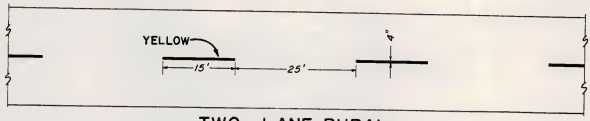
K. School crossings: School crossings should be marked as illustrated on Figure 15. The proper signs should be in place, if possible, at the time the pavement markings are laid down.

L. Railroad crossings: The pavement markings as illustrated by Figure 16, should be placed at all paved approaches to railroad crossings where flashing signals and/or gates are operating, and at all other crossings where the prevailing approach speed is 40 M.P.H. or greater.

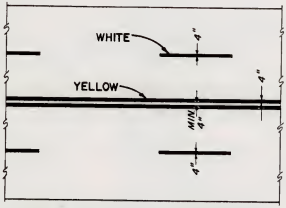
M. Word and symbol markings: These markings are not to be used for mandatory messages except in the support of standard signs. The markings are to be used on the approach to an intersection to supplement Lane-Use-Control signs indicating the types of movement that are permitted from specific lanes. On one-way streets the straight-thru arrow may be used near intersections to indicate the proper direction of traffic flow. (See Figures 17 & 18).

N. Parking space limits: Although the Highway Department does not normally mark parking space, Figure 19 has been included to illustrate the normal limits of such zones. Parking limits in relation to intersections should conform to this standard in order to provide sufficient sight distance and minimize interference of vehicles parking and unparking.

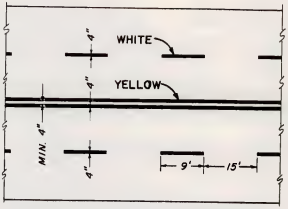
STANDARD PAVEMENT MARKINGS



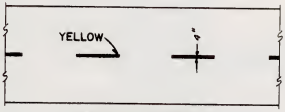
TWO - LANE RURAL
TWO-WAY



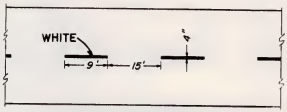
FOUR - LANE UNDIVIDED
RURAL



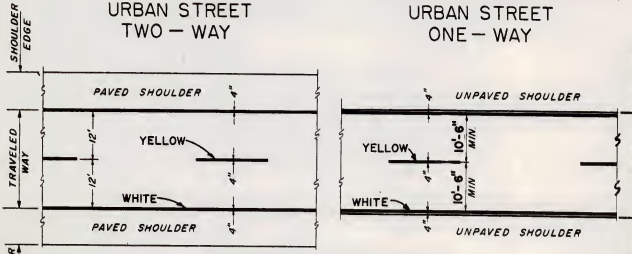
FOUR - LANE UNDIVIDED
URBAN



URBAN STREET
TWO - WAY



URBAN STREET
ONE - WAY

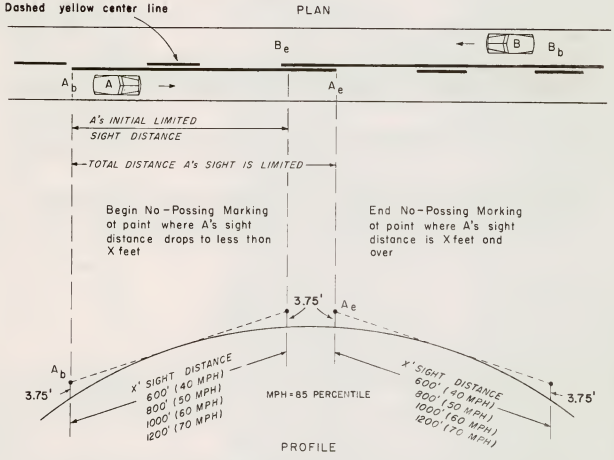


PAVEMENT EDGE LINES

FIGURE 1

STANDARD PAVEMENT MARKINGS

VERTICAL CURVE – TWO LANE PAVEMENT
WHERE SIGHT DISTANCE IS LESS THAN "X" FEET



Note: The method of establishing the no-passing markings, as shown on the profile, is for A's direction only. The method for B's direction is similar.

FIGURE 2

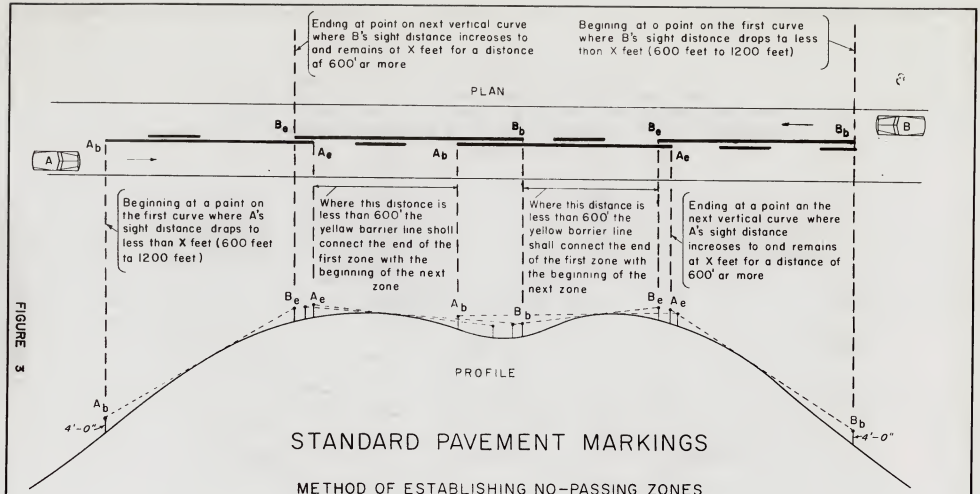


FIGURE 3

STANDARD PAVEMENT MARKINGS

METHOD OF ESTABLISHING NO-PASSING ZONES FOR SUCCESSIVE VERTICAL CURVES* ON TWO-LANE PAVEMENTS

* Successive horizontal curves on two-lane pavements shall be marked similarly

NO - PASSING LINES ON HORIZONTAL CURVES

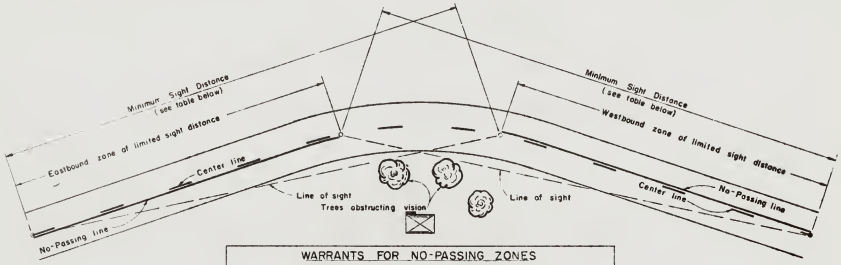


FIGURE 4

WARRANTS FOR NO-PASSING ZONES

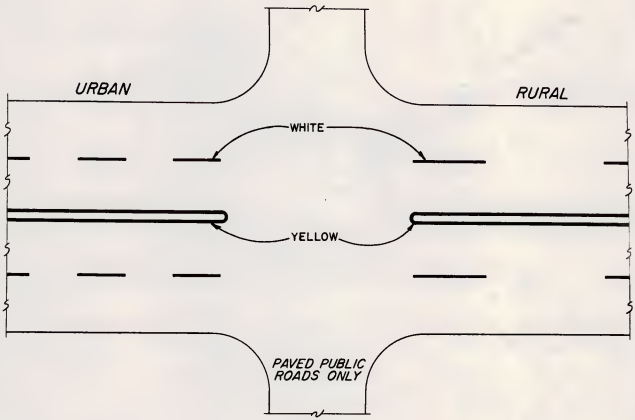
85 PERCENTILE SPEED (mile per hour)	MINIMUM SIGHT DISTANCE (feet)
30	500
40	600
50	800
60	1000
70	1200

NOTES

(1) Begin the No-Passing line when the measured line of sight becomes less than the minimum sight distance
(2) End the No-Passing line when the measured line of sight again exceeds the minimum sight distance.
(3) Consult Table for the minimum sight distance determined by the 85th percentile speed.
(4) The No-Passing lines may or may not overlap depending on the alinement.

INTERSECTION STRIPING

FOUR LANE UNDIVIDED HIGHWAY



NO PASSING ZONES FOR APPROACHES TO NARROW BRIDGES

Striping on structures less than 24' in width, curb to curb, with no other restrictions on sight distance

300' in urban areas.
500' in rural areas.

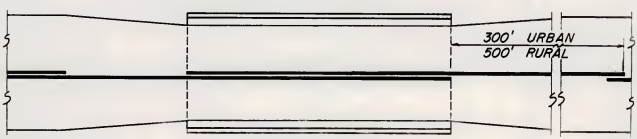


FIGURE 5

NO PASSING ZONES AT INTERSECTIONS

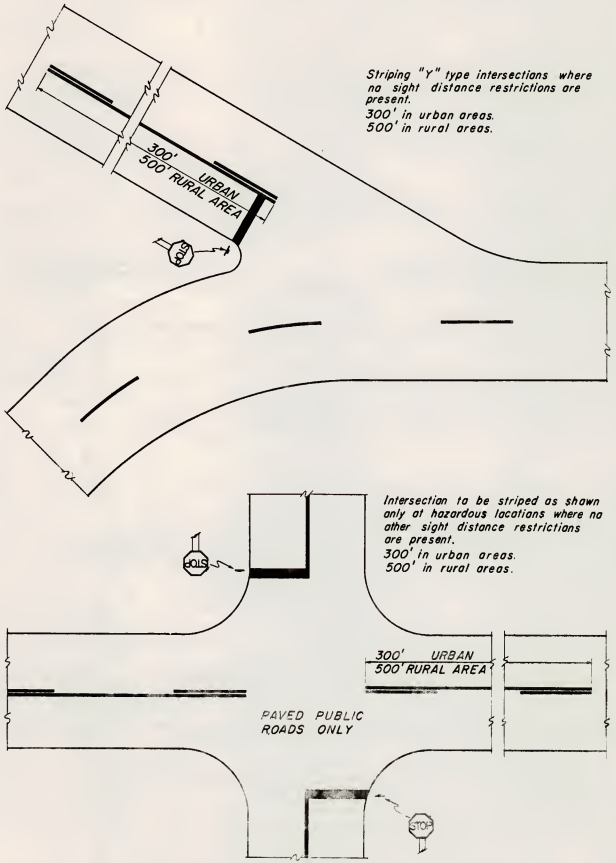


FIGURE 6

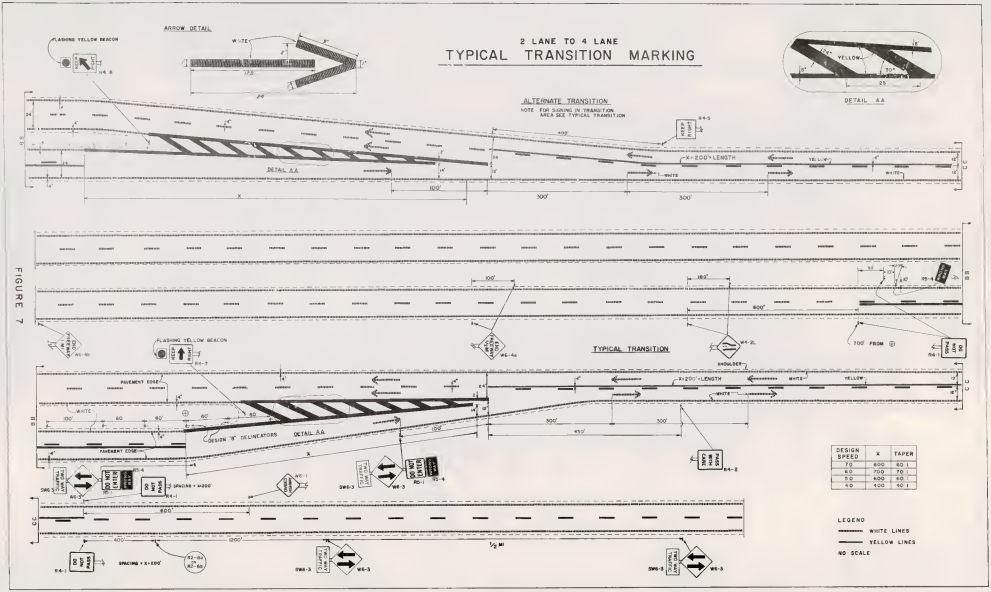

2 LANE TO 4 LANE
TYPICAL TRANSITION MARKING
ARROW DETAIL
FLASHING YELLOW BEACON
WHITE
YELLOW
DETAIL A.A
ALTERNATE TRANSITION
NOTE FOR SIGNING IN TRANSITION AREA SEE TYPICAL TRANSITION
K+200'-LENGTH
300'
100'
TYPICAL TRANSITION
PAVEMENT EDGE
DESIGN 'B' DELINEATORS
DETAIL A.B
SHOULDER
700' FROM ⊕
SPACING = K+200'
DESIGN SPEED | K | TAPER
70 | 600 | 80:1
60 | 700 | 70:1
50 | 600 | 60:1
40 | 400 | 40:1
LEGEND
WHITE LINES
YELLOW LINES
NO SCALE

FIGURE 7

TYPICAL LANE - USE - CONTROL MARKINGS

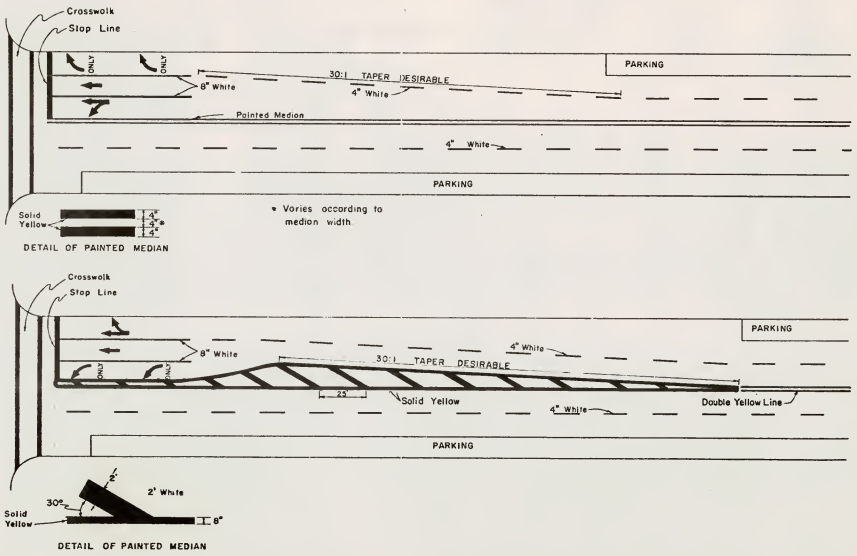


FIGURE 8

CHANNELIZATION MARKINGS

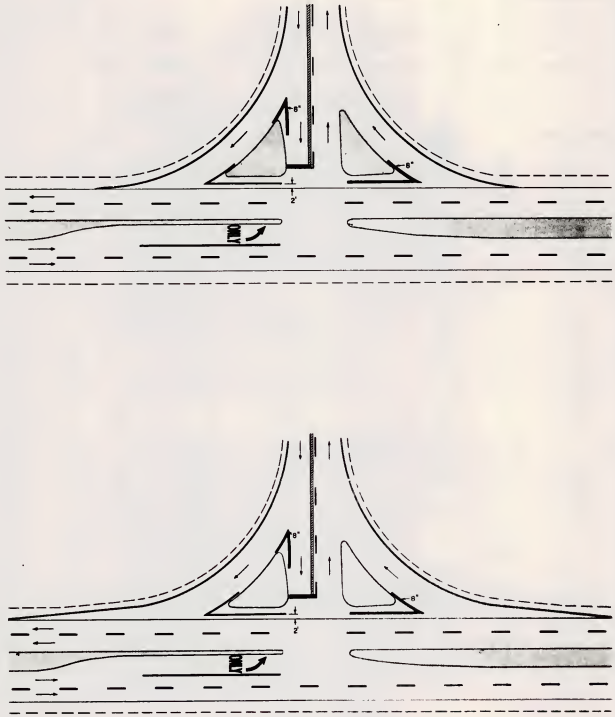
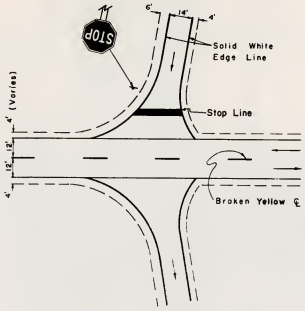
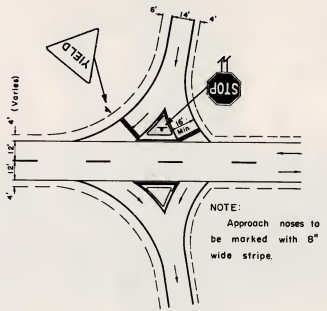


FIGURE 9

TYPICAL RAMP TERMINAL MARKINGS



UN-CHANNELIZED



CHANNELIZED

FIGURE 10

TYPICAL ACCEL & DECEL LANE MARKINGS

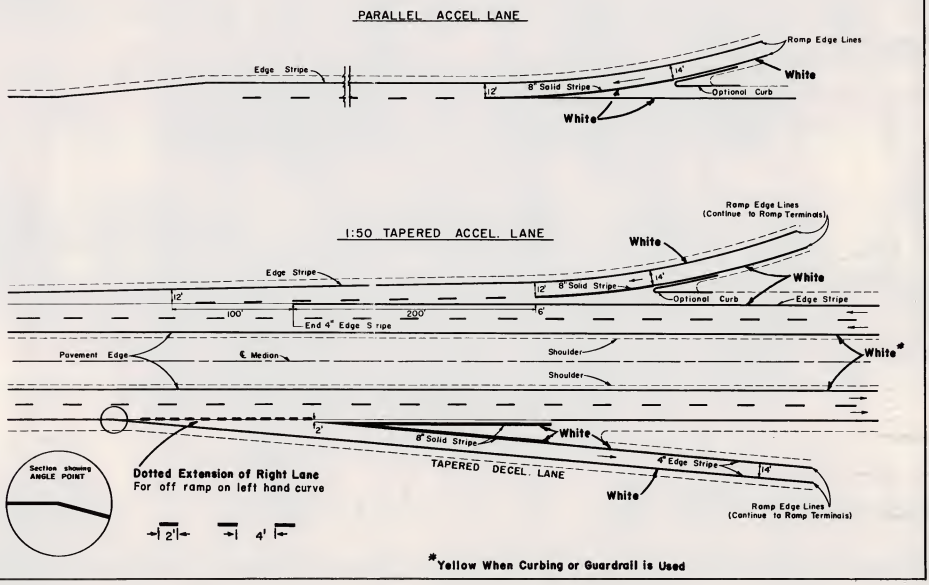
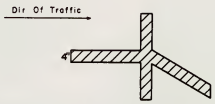


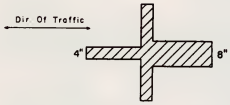
FIGURE 11

STRIPING LAYOUT SYMBOLS

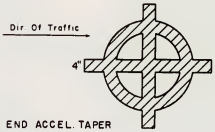
① END OF LINE



② END LINE - BEG. NEW LINE AT ANGLE



③ END 4" LINE - BEG. 8" LINE

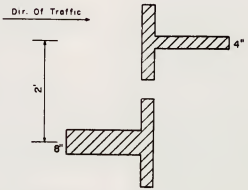


④ END ACCEL. TAPER

⑤ BEG 8" GORE MARKING ON DECEL. LANE

NOTE:

These are standard layout symbols to be used in the typical locations shown on the following page. They also have application on other pavement marking projects. Consistent and proper use of these symbols will promote understanding and eliminate confusion between layout crews, pavement marking crews and others concerned with pavement markings.



⑥ END 8" LINE - BEG. 4" LINE (2' OFFSET)

FIGURE 12

TYPICAL USE OF STRIPING LAYOUT SYMBOLS

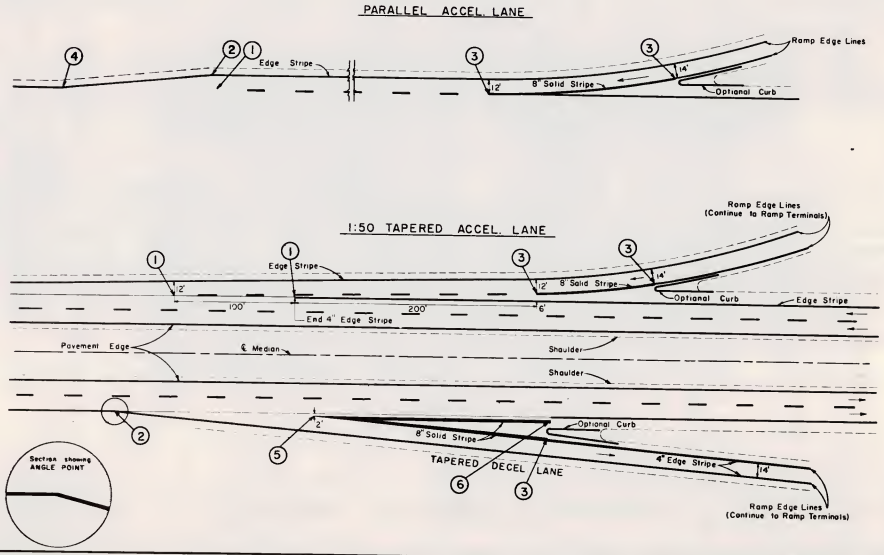


FIGURE 13

STANDARD PAVEMENT MARKINGS FOR TRUCK CLIMBING LANES

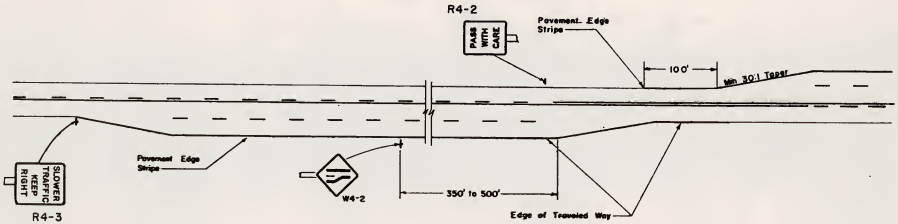


FIGURE 14

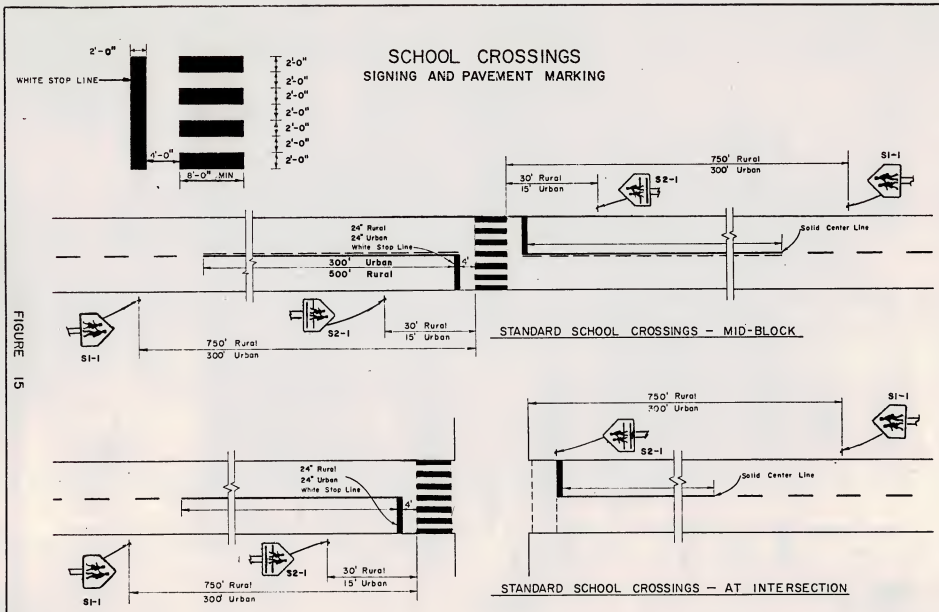

SCHOOL CROSSINGS
SIGNING AND PAVEMENT MARKING
2'-0"
WHITE STOP LINE
4'-0"
8'-0" MIN
2'-0"
2'-0"
2'-0"
2'-0"
2'-0"
2'-0"
2'-0"
750' Rural
300' Urban
30' Rural
15' Urban
S2-1
S1-1
24" Rural
24" Urban
White Stop Line
300' Urban
500' Rural
4'
Solid Center Line
S2-1
30' Rural
15' Urban
750' Rural
300' Urban
S1-1
STANDARD SCHOOL CROSSINGS - MID-BLOCK
750' Rural
300' Urban
S1-1
S2-1
Solid Center Line
24" Rural
24" Urban
white Stop Line
4'
S2-1
30' Rural
15' Urban
750' Rural
300' Urban
S1-1
STANDARD SCHOOL CROSSINGS - AT INTERSECTION

FIGURE 15

RAILROAD GRADE CROSSINGS

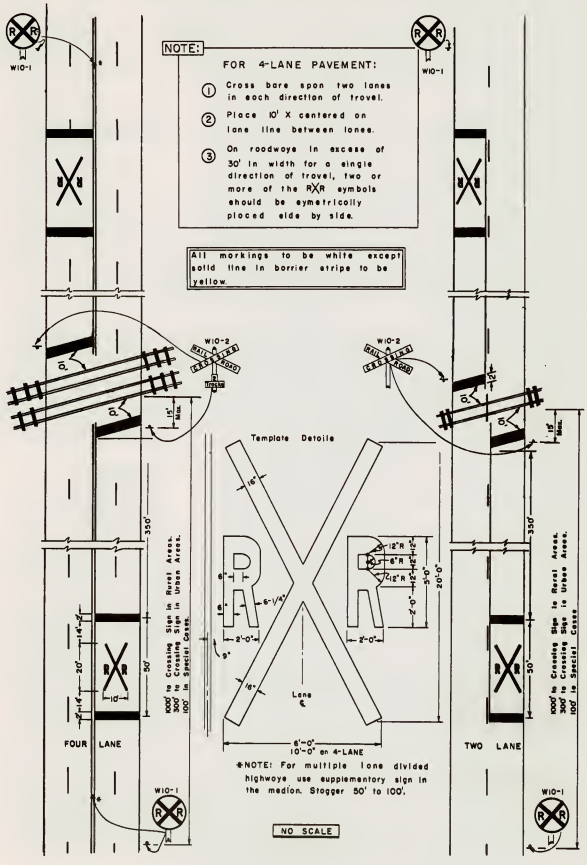


FIGURE 16

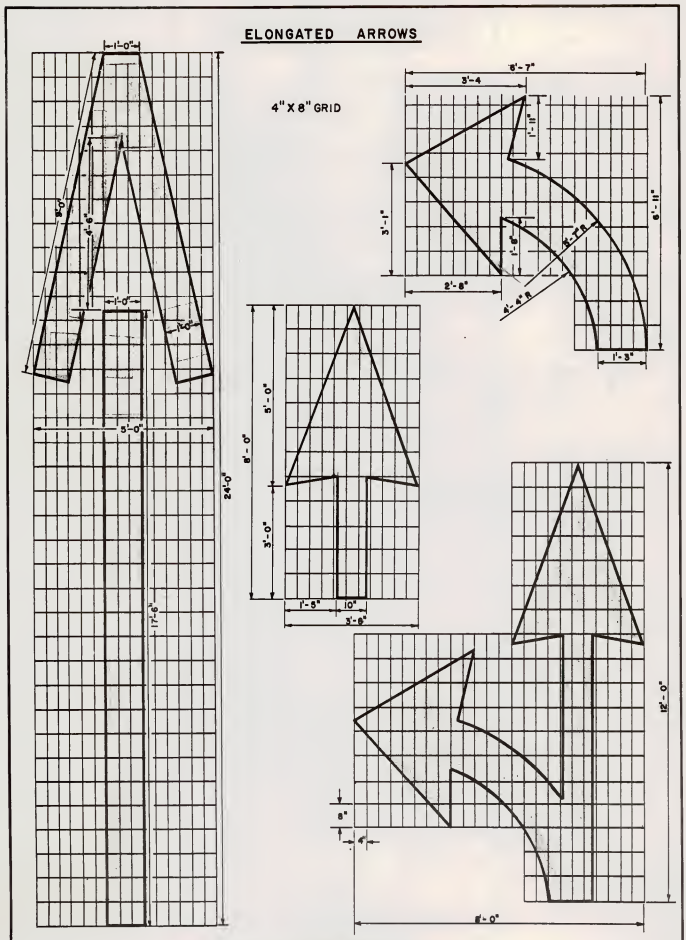

ELONGATED ARROWS
4" X 8" GRID
1'-0"
8'-0"
4'-8"
1'-0"
5'-0"
24'-0"
17'-6"
6'-7"
3'-4
1'-11"
3'-1"
6'-11"
1'-8"
2'-8"
2'-4"R
1'-3"
8'-0"
5'-0"
3'-0"
1'-8"
10"
3'-8"
12'-0"
8"
8'-0"

FIGURE 17

ELONGATED LETTERS

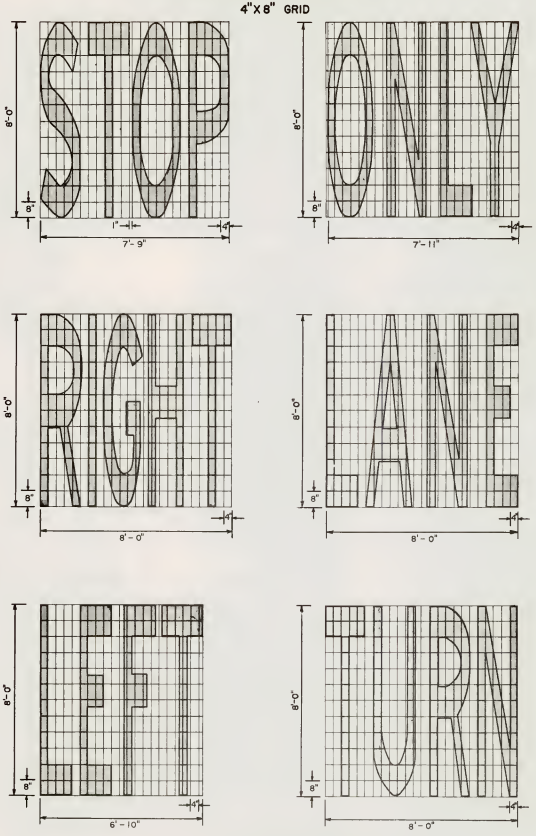


FIGURE 18

STANDARD PAVEMENT MARKINGS

PARKING SPACE-LIMITS & STALLS

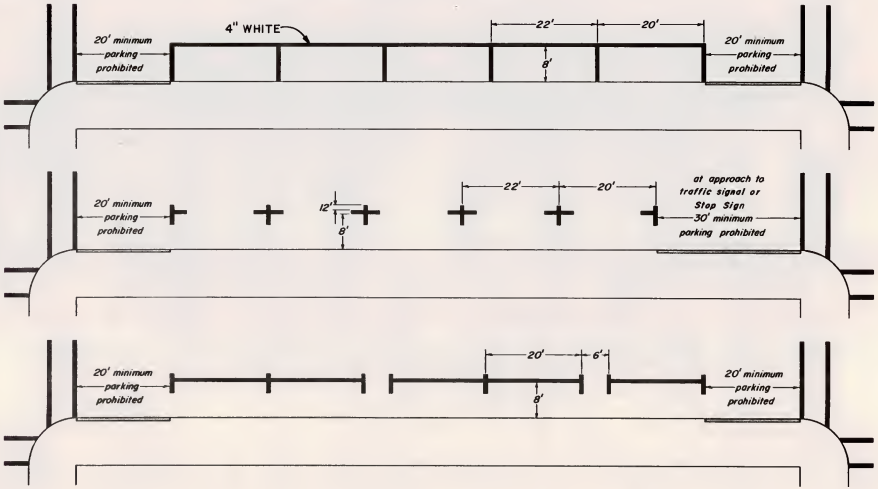


FIGURE 19